

EVALUATION OF THE 2003 MODEL BUILDING CODES

**Office of Statewide Health Planning
and Development
Facilities Development Division**



Overview

- **Evaluation Approach and Process**
- **OSHDP Review Team**
- **Overview of the Findings of the OSHDP Evaluation**
- **Summary**
- **Conclusion**

Introduction

- The purpose of the model building code is to provide for public safety, through an efficient, usable, and consistent set of rules for construction
 - The building code is not a design manual or a guide
- Model codes represent the minimum enforceable standards
- OSHPD must amend model codes to meet its statutory requirements
 - OSHPD amendments are safety-related
- OSHPD has jurisdiction over Hospitals, Skilled Nursing Facilities, Correctional Treatment Centers, and Licensed Clinics

Evaluation Approach

OSHPD has...

- Reviewed the level of safety for both *IBC* and *NFPA 5000*
- Evaluated work needed to amend the codes
- Evaluated ease of use of the two model codes
 - Design
 - Plan review
 - Construction inspection
- OSHPD did not find the code development process relevant to the Evaluation

Evaluation Process

- **Performed a comparative review of the two model codes and the *2001 CBC***
- **Participated in the evaluation of codes in SFM's Operation Code Comparison**
- **Attended training presented by NFPA and ICC**
- **Reviewed code evaluation criteria suggested by interested parties**
- **Attended public meetings**
- **Reviewed code comparisons, summaries, and recommendations**
- **Requested clarification from NFPA and ICC**

Evaluation Process

- **Experienced, multi-disciplined team participated in the evaluation process, including:**
 - **Architects**
 - **Fire/Life Safety Officers**
 - **Mechanical engineers**
 - **Structural Engineers**
- **Review encompassed all aspects of the building code, including fire and life safety provisions promulgated by the State Fire Marshal and enforced by OSHPD**

OSHPD Review Team

Susan Botelho – Staff Services Manager III

- Chief, Regulations Development Section
- Past President, California Capitol Chapter, ICBO

Byron “BJ” Foster – Fire/Life Safety Officer

- Member of the NFPA 5000 Height and Area Committee

Tom Hale – Senior Structural Engineer

- Co-chair of the SEAOC Central Seismology Committee
- Past-chair of the State SEAOC Seismology Committee
- Member of the BSSC/NEHRP 2003 Provisions Technical Subcommittees TS-3 Foundations and Geotechnical Considerations, and TS-12 Base Isolation and Energy Dissipation.

OSHPD Review Team

John Gillengerten – Senior Structural Engineer

- Member, Provisions Update Committee (PUC), BSSC/NEHRP Provisions 1994-present
- Chairman of the BSSC/NEHRP Provisions Technical Subcommittee TS-8, Nonstructural Components and Systems, 1997-present
- Member, ASCE 7 Task Committee on Earthquake Loads, 1998-present
- Member BSSC Code Resource Structural Committee (CRSC), 1997-present
- Member, NFPA 5000 Committee on Structures and Construction

OSHDPD Review Team

Don Harris – Senior Architect

- Member, NFPA 5000 Committee on Health Care Occupancies
- Member, Code 2000 partnership egress working group
- Member, OSFM Code Comparison Committee

Bill Staehlin – Supervising Structural Engineer

- Current President, SEAOC
- Past President, Structural Engineers Association of Central California (SEA OCC)
- Member, ASCE 7 Task Committee on Earthquake Loads, 1998-present
- Member and past chairman of ASHRAE TC2.7 Seismic Restraint Design

OSHDPD Review Team

Chris Tokas – SB 1953 Program Manager

- Past President, SEA OCC
- Member, ASCE 7 Task Committee on Earthquake Loads
- Past Chair, SEA OCC Seismology Committee
- Chair, SEA OC Seismology Committee, 2001 to present
- Member, International Building Code Structural Committee, 1998 - 2002

Level of Safety

- **The level of safety provided by a code is directly proportional to the number of amendments required**
 - **The fewer amendments in a code, the greater the level of safety provided by a building constructed to that code**
- **Ease of amendment can be hampered or enhanced by format**

Code Support

- **Building code support and product evaluation services are fully in place for the IBC, and promised by NFPA**
- **NFPA has extensive experience supporting their standards, but they have no experience providing support for a building code**
- **There is insufficient data available to be able to evaluate the NFPA support services**

Fire and Life Safety Evaluation

- **Performed a comprehensive review of portions of the model codes for occupancies under our jurisdiction (included fire and life safety, structural and other provisions)**
- **Requested clarification from code organizations related to fire and life safety issues**
- **Major portions of our report address fire and life safety/architectural issues**

Fire and Life Safety Evaluation

- **Level of protection in IBC and NFPA 5000 are substantially lower than the CBC**
- **In general, level of fire and life safety provided by IBC and NFPA 5000 is roughly equal.**
- **NFPA 5000 allows much greater height and area for licensed clinics (treated similarly to business occupancies)**

Operation Code Comparison

- OSHPD Participated in and utilized the State Fire Marshal's "Operation Code Comparison"
- Different conclusion from SFM
 - NFPA 5000 does not provide greater level of safety
 - Firefighter safety is addressed in both codes
 - 4-hour rated construction for high rise can be amended by SFM is justified, but this has never been proposed in the past

National Structural Standards

- Structural standards are now prepared at the national level
- National Earthquake Hazard Reduction Program *Recommended Provisions for Seismic Regulations for New Buildings (NEHRP Provisions)*
- American Society of Civil Engineers *Minimum Design Loads for Buildings and Other Structures (ASCE7-02)*

Reference Documents (Standards and Publications)

- **Both model codes use reference documents**
- **IBC amends these documents for safety and consistency**
- **In general, NFPA 5000 has not been amended to resolve conflicts with the structural material standards**
 - **NFPA states that their committees have authority to amend referenced standards to resolve conflicts**

Structural Materials Standards

- **Different organizations publish standards for the design and use of various structural materials, for example:**
 - **American Concrete Institute (ACI)**
 - **ACI 318 – Concrete Design**
 - **ACI 530 – Masonry Design**
 - **American Iron and Steel Institute (AISI)**
 - **Cold-Formed Steel Specifications**
 - **American Institute of Steel Construction (AISC)**
 - **Specifications for Structural Steel Buildings**

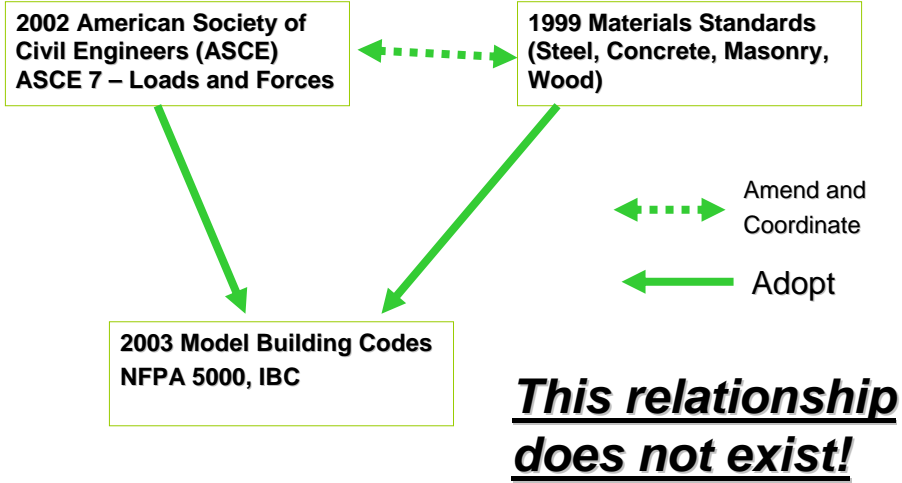
Amending Structural Reference Standards

- At the national level, material standards are considered for adoption into the NEHRP Provisions and ASCE 7
- NEHRP and ASCE both amend material standards if they are deemed inadequate
 - The amendments are found in the materials chapters of the NEHRP provisions and Section A9, “Supplemental Provisions” of ASCE 7
- Use of un-amended materials standards for seismic design may result in unsafe conditions

Structural Reference Standards and ASCE 7-02

- ASCE 7-02 (referenced by both codes) is based on the 1999 editions of the steel, concrete and masonry standards
- Both codes reference the 2002 editions of the steel, concrete and masonry standards

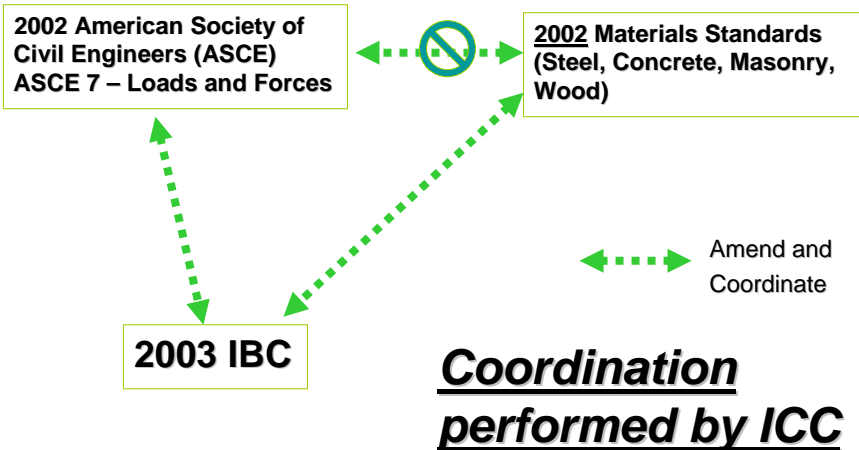
Ideal Relationship of Structural Standards



IBC and the Material Standards

- IBC simply does not adopt the sections of ASCE 7-02 covering material standards
- Each material chapter in the IBC has been amended to coordinate the 2002 edition material standards and ASCE 7-02

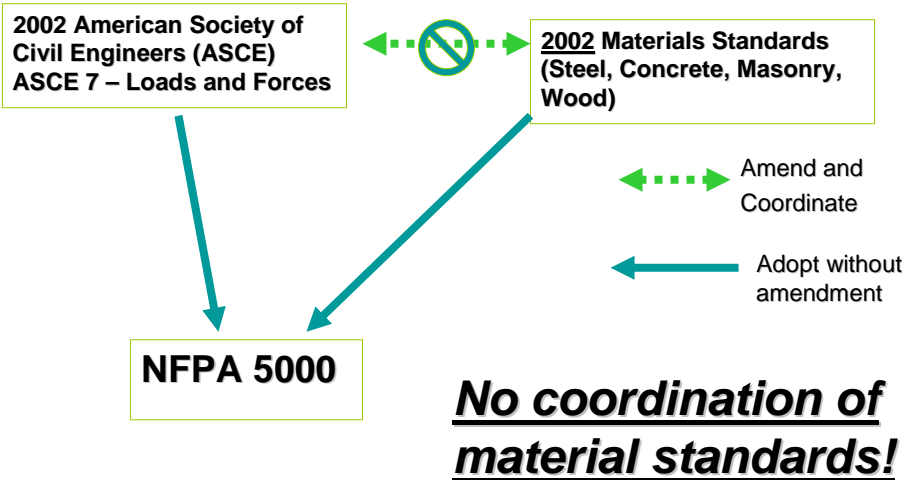
Relation of IBC and Structural Standards



NFPA 5000 and Reference Documents

- NFPA adopts all of ASCE 7-02, but then also adopts 2002 edition material standards that conflict with ASCE 7-02
- No amendments were made to coordinate the 2002 editions of the material standards with ASCE 7-02

Relation of NFPA 5000 and Structural Standards



Precedence of Referenced Standards and Publications

- Both ICC and NFPA were asked whether secondary and tertiary references (i.e., references in a referenced document) are valid
- ICC stated that standards referenced within another standard are valid
- NFPA initially stated that secondary and tertiary references are not valid, but subsequently reversed their position

NFPA and Conflicts Between Reference Documents

- **OSHPD posed the question:**

“If a referenced publication in turn references other documents, are these documents also considered to be part of the building code?”
- **NFPA Response, 5/20/2003**

“In general, secondary and tertiary references in the referenced documents are not considered to be part of the NFPA code...”
- **NFPA Comment, 6/27/2003**

“With respect to secondary and tertiary referenced documents, NFPA 5000 Section 2.1 states “The documents or portions thereof listed in this chapter are referenced within this Code and shall be considered part of the requirements of this document”. So, the provisions of a referenced standard apply.”

Illustrating Code Conflicts Masonry Design and NFPA 5000

- NFPA 5000 adopts ACI 530-02 without amendment
- ASCE 7-02 references ACI 530-99
- NFPA 5000 Section 1.3.2 states that where the requirements of a referenced code or standard differ from NFPA 5000, the requirements in NFPA 5000 shall govern
- Since NFPA 5000 Section 43.3 explicitly requires that masonry structures be designed in accordance with ACI 530-02, that edition must be used

Illustrating Code Conflicts Masonry Design and NFPA 5000

- **The 2002 edition, ACI 530-02 was reformatted**
 - **Section numbers are different from those in 1999 edition, ACI 530-99.**
- **Significant amendments to ACI 530-02 relating to seismic safety have been proposed for 2003 NEHRP Provisions**
 - **11 Change proposals, over 35 pages long**
 - **These amendments will be made in ASCE 7-05**

Illustrating Code Conflicts Masonry Design and NFPA 5000

- **ASCE 7-02 is not coordinated with ACI 530-02**
- **Of 11 specific references in ASCE 7-02 to the masonry standard mandated by NFPA 5000...**
 - **5 refer to sections that don't exist**
 - **2 refer to incorrect sections**
 - **4 are correct**

Illustrating Code Conflicts Masonry Design and NFPA 5000

- **Simply correcting the section references is not enough – the other technical issues raised in the 2003 NEHRP must also be addressed**
- **This situation was raised as a question to NFPA**
- **NFPA response:**

“It is certainly in California’s best interests to adopt and enforce the most up-to-date codes and standards available. Consequently, as part of the review process, California will want to compare the seismic provisions of ACI 530-99 with ASCE 7-02’s modifications to those of ACI 530-02 to determine if there are conflicts and how best to deal with those conflicts.”

Masonry Design in IBC

- **No conflicts arise from the adoption of both ASCE 7-02 and ACI 530-02 in the IBC**
- **IBC does not reference ASCE 7-02, Section A9.11, (the section that references ACI 530-99).**
- **Instead, IBC Chapter 21 contains a complete set of seismic design regulations for masonry.**
 - **IBC is coordinated with the appropriate sections of ACI 530-02**
 - **IBC appears to embrace a number of the issues covered in the proposed amendments to ACI 530-02 being considered for the 2003 NEHRP provisions.**

Another Illustration Standards versus Publications

- **NFPA uses “referenced publications” including manuals and handbooks that are not be written in an enforceable style**
- **IBC uses “referenced standards” which generally are enforceable and which IBC has amended for safety, clarity, and ease of use**
- **The hazards of adopting “publications” are illustrated by the NFPA 5000 wood chapter**

Wood Design in IBC

- **Chapter 23 of the *IBC*, covering wood construction, is a comprehensive presentation of wood design**
- **Compared to the 2001 *CBC*, the chapter is better organized, more concise, and very usable**
- ***IBC* Chapter 23 contains requirements for both engineered and conventional construction.**

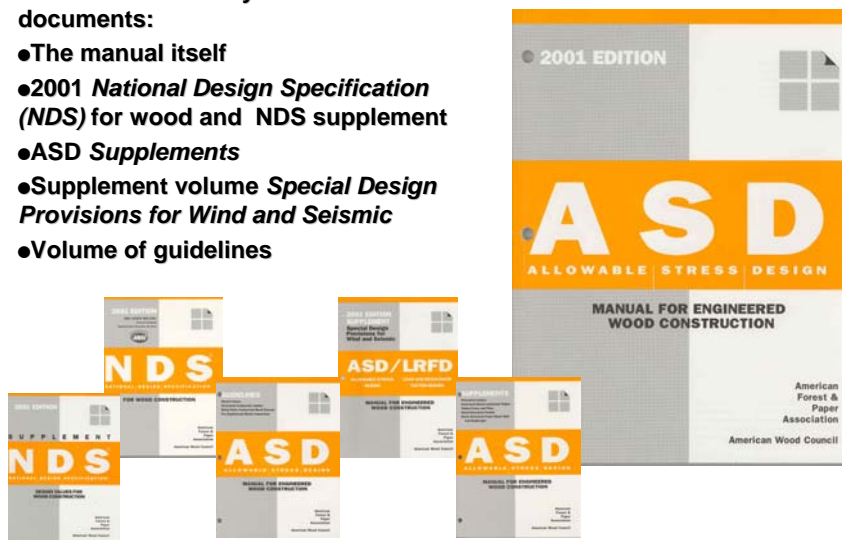
Wood Design in NFPA 5000

- There are 2 methods of design wood, Allowable Stress Design (ASD) and Load Resistance Factor Design (LRFD)
- In the 2001 CBC, wood frame construction is designed using the Allowable Stress Design method.
- The corresponding provisions in *NFPA 5000* consist of a primary reference, the American Forest Products and Paper Association (AF&PA) *Allowable Stress Design (ASD) Manual for Engineered Wood Construction*.
- This reference is unenforceable as written

Wood Design in NFPA 5000

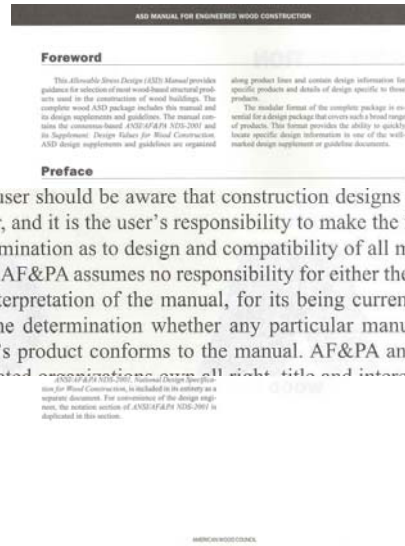
ASD manual actually consists of six documents:

- The manual itself
- 2001 *National Design Specification (NDS)* for wood and NDS supplement
- ASD Supplements
- Supplement volume *Special Design Provisions for Wind and Seismic*
- Volume of guidelines



Wood Design in NFPA 5000

- The AF&PA ASD Manual is the primary wood reference in NFPA 5000
- ASD Manual is intended as a reference for designers, not a code



Wood Design in NFPA 5000

- The AF&PA ASD Manual States on Page 5:

“As a first step, the authority having jurisdiction where a proposed building is to be constructed must be consulted for the requirements of the specific design project. This normally concerns the type of construction desired as well as allowable building areas and heights for each construction type.”

Wood Design in NFPA 5000

- The AF&PA ASD Manual is 98 pages long
- 20 pages are devoted to case studies that belong in a Commentary, not a building code

ADD MANUAL FOR ENGINEERED WOOD CONSTRUCTION

PROJECT PROFILES: CASE STUDIES

2.1	General Information	10
2.2	Commercial/Industrial	10
2.3	Residential/Retail	10
Projects:		
	Fast Food Restaurants	11
	TYCO Warehouse	14
	Reservoir Cover	17
	Marriott Courtyard Hotels	20
	Delaney Street Foundation Triangle	22
	Pine Square/Pacific Court	26

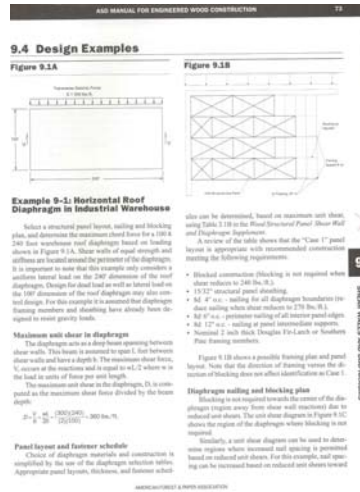
ADDENDUM 1: WOOD JOINTS AND CONNECTIONS

Wood Design



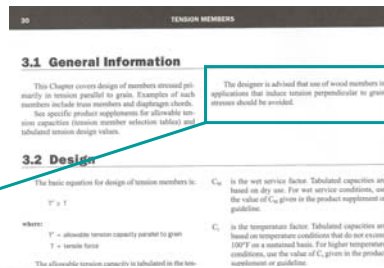
Wood Design

- 17 pages are devoted to simple design examples
- 20 pages are devoted to “General Information” that is usually found in structural engineering textbooks (beam tables, material weights, etc.)
- Over one-half of the manual is clearly non-code material



Wood Design

- The AF&PA ASD Manual is written in vague, unenforceable language



The designer is advised that use of wood members in applications that induce tension perpendicular to grain stresses should be avoided.

Wood Design

- ASD contains conflicting provisions in different volumes
- There are no provisions to indicate which volume take precedence
 - Shear wall and diaphragm design provisions and tables occur in two different volumes
 - The design values and procedures are different

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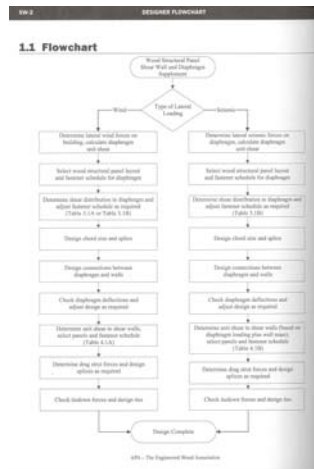
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ASD Supplement

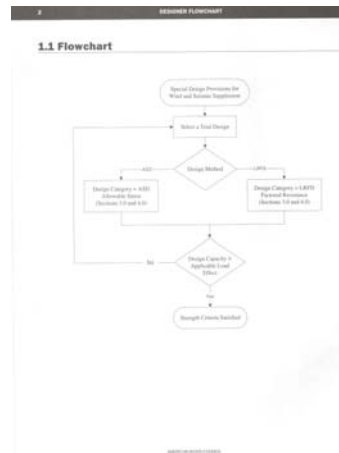
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Supplement - Special Design Provisions for Wind and Seismic

Wood Design



ASD Supplement



Supplement - Special Design Provisions for Wind and Seismic

Another Illustration -Foundation Design in NFPA 5000

- **NFPA Soils, Foundations, and Retaining Walls Chapter is vague and incomplete**
 - References to other documents are too broad
For example,
 - **NFPA 5000 Section 36.1.1 states that foundations must meet ASCE7-02, Sections 9 and A9.7**
 - **This is over 100 pages (the entire Seismic Design Section!)**
 - **Many important topics are not covered**

Another Illustration -Foundation Design in NFPA 5000

- **Sample provision - NFPA 5000**

Section 36.9 Retaining Walls...

36.9.1 Design. Retaining walls shall be designed to resist design loads in Chapter 35 and to insure stability against overturning, sliding, excessive foundation pressure, and water uplift.

References the entire structural Chapter

What is “excessive”?

Do you need a Factor of Safety?

Foundation Topics in IBC not present in NFPA 5000

Partial listing...

- Frost Protection
- Footings on or adjacent to slopes
- Footing widths for light frame construction
- Design for expansive soil
- Pier Foundations
- Permissible bearing values for gravel and rock sites

Foundation Design in 2003 IBC

IBC Soils and Foundations Chapter is an improvement over the 2001 CBC

- **For seismic design, specific requirements (and section references) are cited**
- **Example:**
Section 1805.9 Seismic Requirements. See Section 1910 for additional requirements for footings and foundations of structures assigned to Seismic Design Category C, D, E, or F.

For structures assigned to Seismic Design Category D, E, or F, provisions of ACI 318, Section 21.8.1 to 21.8.3 shall apply...

Summary

- **OSHDP has determined that both codes provide roughly equivalent fire/life safety protection, though at a lower level than that provided by the CBC**
- **There are significant safety and usability issues with the structural chapters of NFPA 5000**
- **If adopted, usability issues of NFPA 5000 will result in longer design times, and delays in review – all of which translate into costs to the state and the public**

Summary

- **NFPA 5000 does not establish a minimum standard for wood construction, which represents the majority of construction in California**
- **Neither fire and life safety, or structural provisions can be considered separately**
- **If you cannot build a safe structure, the fire and life safety provisions are of no significance**

Conclusion

- **OSHPD proposes adoption of the International Building Code and International Fire Code as the model codes to serve as the basis for the California Building Code and California Fire Code**